The Eye

Vision, one of the *special senses,* relies on a very complex receptor apparatus, the **eye.** Vision depends on a variety of positioning and focusing mechanisms to form an image in the correct spot on the light-sensitive receptor cells inside the eye. These mechanisms involve muscles, lenses, and other structures that are all a part of the visual apparatus. The complexity of structure allows for complexity of function. The visual image perceived by humans has the qualities of **resolution, brightness, color,** and **depth.** These and other aspects of visual structure and function are presented in this exercise and in Exercise 31.

Before you begin

❑ Read Chapter 15 in your textbook.

❑ Set your learning goals. When you finish this exercise, you should be able to
- ❑ describe the major features of the eye and identify them in specimens, models, and figures
- ❑ explain the basic function of the eye and its structures

❑ Prepare your materials:
- ❑ sheep or beef eye (fresh or preserved)
- ❑ dissection tools and trays
- ❑ chart or dissectible model of the eye
- ❑ microscope
- ❑ prepared microslide: *retina c.s.*
- ❑ computer setup with DISSECTIBLE HUMAN or similar human dissection program (optional)

❑ Read the directions and safety tips for this exercise **carefully** before starting any procedure.

HINT

Using the DISSECTIBLE HUMAN or similar computerized human dissection program, explore the human body and try to find the structures listed in this activity.

A. The human eye

The human eye and its accessory structures provide the structural apparatus required for processing and receiving visual images. Using charts or dissectible models of the human eye and its accessories, locate each of the parts listed and describe its function in Lab Report 30.

❑ 1 Locate these features of the **lacrimal apparatus** (Figure 30-1):

- ❑ **Lacrimal gland**—Exocrine "tear" gland i
superior lateral corner of the orbit.
- ❑ **Nasolacrimal duct**—Duct in the inferior
corner of the orbit, drains tears from **lacrima**
toward the nasal cavity.

❑ 2 Locate these *extrinsic eye muscles,* which are s
muscles that control eye movement:
- ❑ **Rectus muscles**—(four) *Superior, inferior, lateral*
- ❑ **Oblique muscles**—(two) *Superior, inferior*

What is the action of each of these muscles?

❑ 3 Identify these additional accessory structures
- ❑ **Eyelids**
- ❑ **Conjunctiva**—Thin, transparent mucous
brane adhering to the anterior surface of the
lining the eyelids.
- ❑ **Eyebrows**

❑ 4 Distinguish the three *coats* of the eyeball:
- ❑ **Outer coat**—The **cornea** is the anterior, tr
ent portion. The **sclera** is the white, fibrous p
- ❑ **Middle coat**—The posterior portion is the
heavily pigmented **choroid.** The anterior por
include the circular **ciliary body,** in which ar
porated the **ciliary muscles** *(intrinsic eye mus*
The ciliary muscles are attached to the rim of
lens by means of **suspensory ligaments.** Att
to the anterior edge of the ciliary body is the
iris, which has an opening called the **pupil.**
- ❑ **Inner coat**—The **retina** is divided into tw
ers: the outer *pigmented retina* and the inner s
retina. The sensory retina contains photorecep
cells of two types: **rods** and **cones,** as well as
ation neurons. In the posterior retina is a sma
low **macula lutea** with a pit called the **fovea**
tralis. The fovea is normally the center of the
field and contains many cones. Rods become
dominant farther away from the fovea. Medi
the macula lutea is the white **optic disc.** Here
vessels, as well as the nerve fibers that exit as
optic nerve, pass out of the eyeball.

SAFETY FIRST!

Do not forget the rules for safe use of the microsco

❑ Observe a cross section of the retina in a prepared microscopic specimen. Can you identify the features of the retina shown in Figure 30-2? Are either of the other two coats of the eyeball visible in your specimen?

HINT

LABORATORY REFERENCE Plate 50 shows a light micrograph of the retina.

❑ 5 Identify these cavities and chambers of the eye:
❑ **Anterior cavity**—Filled with **aqueous humor,** a watery filtrate produced by the ciliary body. Aqueous humor circulates from the **posterior chamber** behind the iris, through the pupil, to the **anterior chamber,** where it is reabsorbed.
❑ **Posterior cavity**—Filled with transparent, jellylike **vitreous humor.** This cavity is posterior to the lens.

B. Eye dissection

Apply your knowledge of mammalian eye anatomy by carefully dissecting a cow or sheep eye.

SAFETY FIRST!

Observe the usual precautions while dissecting the preserved or fresh tissue of the eye specimen. Use safety goggles to avoid injury during dissections.

❑ 1 Trim away any excess adipose tissue, leaving the stub of the optic nerve and extrinsic eye muscles intact.

❑ 2 Locate these structures on the external aspect:
❑ **Optic nerve**—The nerve bundle projecting from the posterior of the eyeball.
❑ **Extrinsic eye muscles** (six)—These may have been cut from your specimen during preparation (Figures 30-3 and 30-4).
❑ **Sclera**—The white portion of the outer coat.
❑ **Cornea**—The clear, anterior portion of the outer coat.
❑ **Iris**—The pigmented region under the cornea.
❑ **Pupil**—The iris's hole (it may be oblong in your specimen rather than round as in the human).
❑ **Conjunctiva**—The thin mucous membrane over the anterior portion of the eye, extending to line the inner eyelid.
❑ Any other accessory structures that may be present in your specimen.

❑ 3 Puncture the sclera with the tip of your scissors (or a scalpel) about 1 cm posterior to the edge of the cornea. Use the scissors to cut a circle around the eye, staying 1 cm from the cornea's margin. Pull the anterior portion away from the posterior portion.

❑ 4 Identify these features:
❑ **Vitreous humor**—The thick fluid of the **posterior cavity.**
❑ **Aqueous humor**—A watery liquid in the **anterior cavity.**
❑ **Lens**—A plasticlike ball of translucent tissue (in fresh specimens it is very clear; hold it up and try to look through it).
❑ **Ciliary body**—A ring of ridges around the outside of the iris's margin (the ridges are formed by the ciliary muscles within).
❑ **Retina**—A thin film of gray matter loosely associated with the inside posterior wall of the eyeball (it may have fallen away, appearing as a crumpled mass still attached at the **optic disc**).
❑ **Choroid**—The pigmented region of the **vascular tunic** in the posterior region of the eyeball's wall, deep to the sclera, superficial to the retina (in some mammals, but not in humans, an iridescent **tapetum lucidum** can be seen in the choroid).

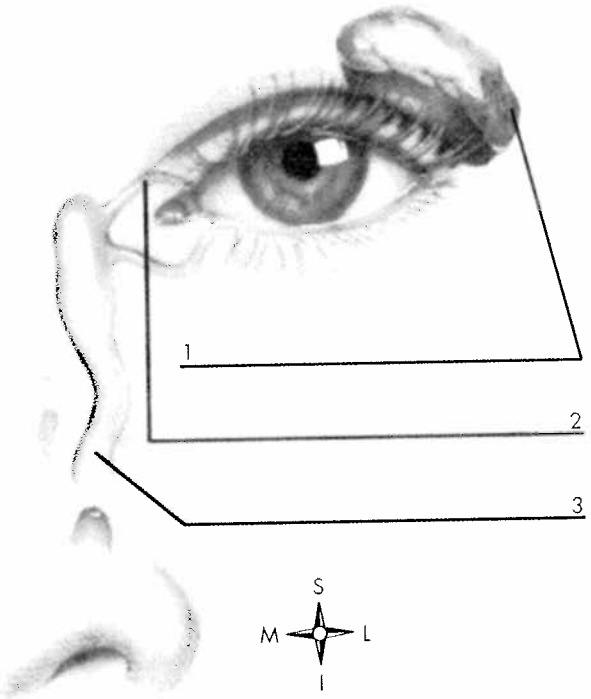


Figure 30-1 Label these parts of the lacrimal apparatus on the lines provided and on the blanks in the Lab Report at the end of this exercise.

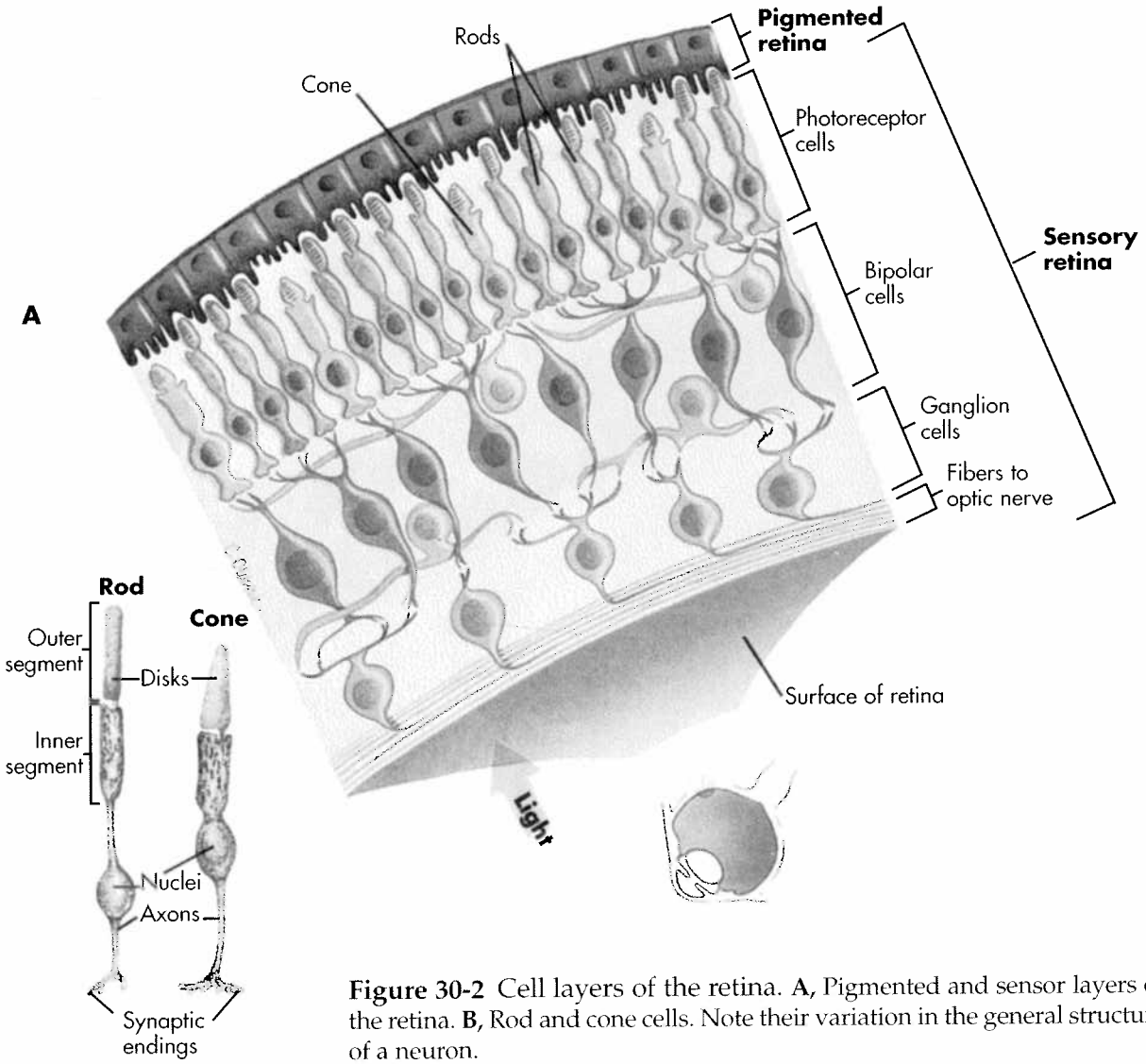


Figure 30-2 Cell layers of the retina. **A,** Pigmented and sensor layers of the retina. **B,** Rod and cone cells. Note their variation in the general structure of a neuron.

COLORING EXERCISE
Using colored pens or pencils, shade in the figure and accompanying labels in contrasting colors of your choice as indicated by the red numerals.

The Eye

OUTER COAT 1
CORNEA 2
SCLERA 3
MIDDLE COAT 4
CHOROID 5
CILIARY BODY 6
IRIS 7
LENS 8
INNER COAT 9
RETINA 10
AQUEOUS HUMOR 11
VITREOUS HUMOR 12
CONJUNCTIVA 13

EXTRINSIC MUSCLES

SUPERIOR RECTUS 14
INFERIOR RECTUS 15
LATERAL RECTUS 16
SUPERIOR OBLIQUE 17
INFERIOR OBLIQUE 18

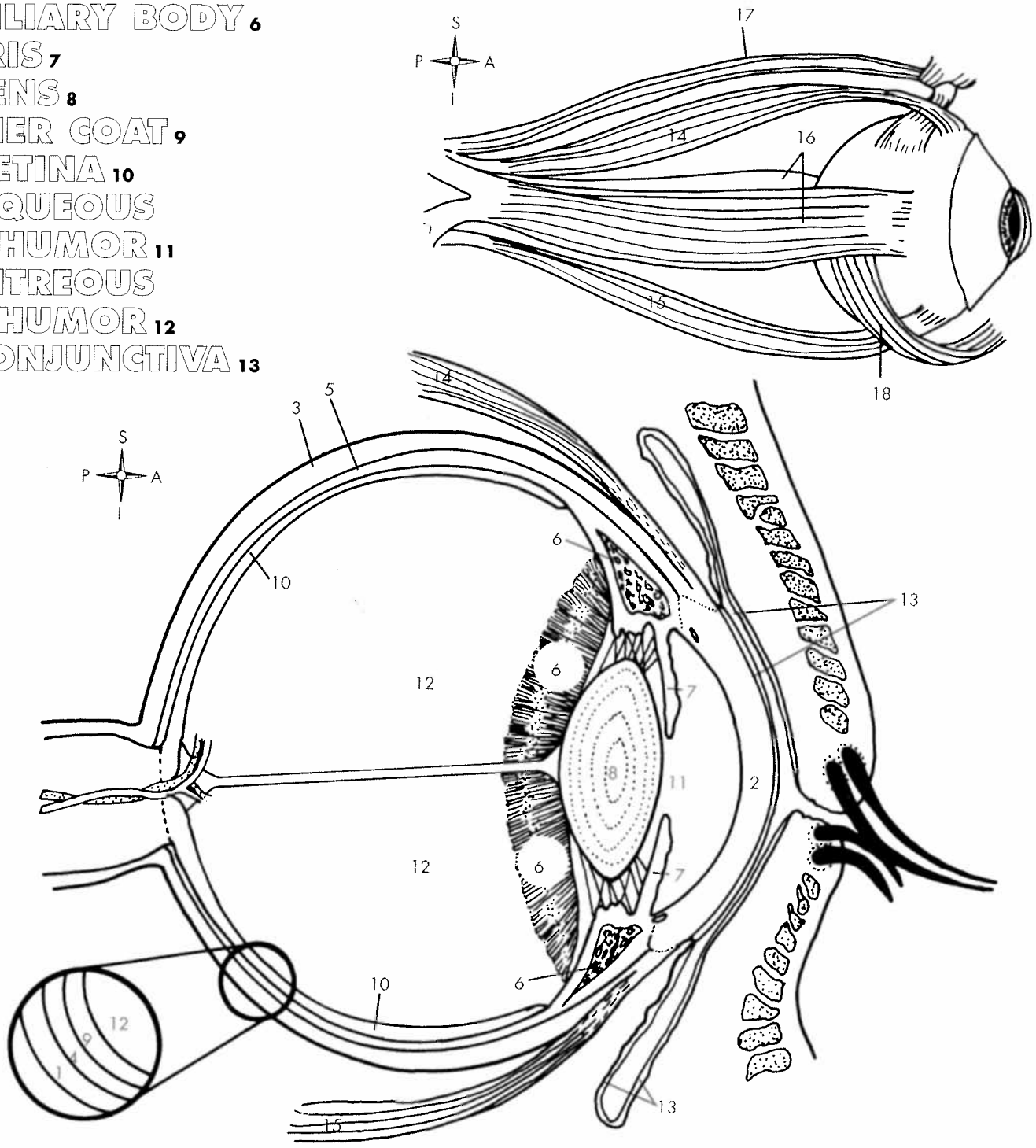


Figure 30-3 Muscles of the eye.

Name: _____ **Date:** _____ **Section:** _____

LAB REPORT 30

The Eye

Use this table as a checklist for your study of the human and sheep (or beef) eye. Do not forget to fill in the function column.

Tunic or Region	Structure	Sheep	Human	Dissectible Human	Function(s)
Lacrimal apparatus	Lacrimal gland	❑	❑	❑	
	Nasolacrimal duct	❑	❑	❑	
Extrinsic eye muscles	Rectus: superior, inferior, lateral, medial	❑	❑	❑	
	Oblique: superior, inferior	❑	❑	❑	
External accessories	Conjunctiva	❑	❑	❑	
	Eyelids, eyebrows	❑	❑	❑	
Outer coat	Cornea	❑	❑	❑	
	Sclera	❑	❑	❑	
Middle coat	Choroid	❑	❑	❑	
	Ciliary body	❑	❑	❑	
	Lens	❑	❑	❑	
	Suspensory ligaments	❑	❑	❑	
	Iris	❑	❑	❑	
	Pupil	❑	❑	❑	
	Tapetum lucidum	❑	❑	❑	
Inner coat	Retina	❑	❑	❑	
	Macula lutea	❑	❑	❑	
	Fovea	❑	❑	❑	
	Optic disc	❑	❑	❑	
Anterior cavity	Aqueous humor	❑	❑	❑	
Posterior cavity	Vitreous humor	❑	❑	❑	
	Optic nerve	❑	❑	❑	

Figure 30-1

1. _____
2. _____
3. _____

Fill-in

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Put in Order

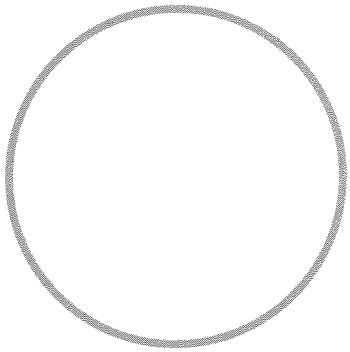
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Fill-in (complete each statement with the correct term)

1. __?__ is a type of photoreceptor specialized for vision in dimly lit environments.
2. Tears are produced by the __?__ glands.
3. When you try to keep your eyes focused on a rocket as it ascends, you contra the __?__ muscle attached to your eyeballs.
4. Muscles in the __?__ relax or contract to alter the diameter of the pupil.
5. The redness seen in one's eyes in a smoke-filled environment is a result of ten porary inflammation of the __?__.
6. On a hot day, sweat collects on your forehead. It is prevented from dripping c rectly toward your eye by the __?__.

Put in Order (arrange these in the order in which light passes through them t form an image inside the eye)

conjunctiva
cornea
lens
pupil
retina
vitreous humor



Specimen: *retina c.s.*

Total Magnification: _____